



FEATURE ARTICLE:  
THE FORCE OF AUTOMATION



## THE FORCE OF AUTOMATION

Speculation has been running rampant as to the potential ramifications of the current pace of the adoption of automation technologies in the workplace. From one extreme to the other, studies have projected that as much as half of all jobs are at risk of being fully automated over the next few decades, while others have estimated that only 5% of jobs are at risk. While it is difficult to say what the full extent will be in terms of the potential for robots and automation technologies to reduce the need for human labour and skills, it is becoming clear that introducing automation in the workplace has already created a significant headwind for wage growth around the world. In late June, the governor of the RBA said that Australian workers are *'worried about foreigners and robots'*, and that this worry regarding the increased competition has discouraged Australian workers from asking for a raise. Low wage growth is an issue that central banks around the world have been forced to grapple with.

In this month's feature article, we discuss the implications that the current pace of change in terms of technological advances could have on global economic growth, productivity and labour markets. We discuss the implications and the benefits that have already arisen from the changing technological landscape, and then show why neither the First and Second Industrial Revolutions provide a reasonable precedent for what to expect going forward. Finally, we address why central banks and governments may need to get involved if the labour markets are impacted as significantly as some forecasts are currently suggesting they will be.

### 1.1 Forecasts for the Impacts Vary Significantly

The debate regarding both the benefits and the fall-out from the ever-changing technological landscape has been reenergised over the past couple of years given the suddenly strong progress made in the AI and machine learning spaces. The forecasts put forward as to the implications of the current Digital Age and the rapid technological change underway on the labour force vary wildly by the source. Thus, it is critical to understand the differing viewpoints before forming a view on what could be plausible.

#### **Frey and Osborne**

A study by Dr. Carl Frey of Oxford Martin School and Dr. Michael A. Osborne of the University of Oxford released in 2013 is one that is often quoted to back up an argument for how severe the implications of automation could be. The study was based on analysis of more than 700 occupation types,

incorporating the skills required and the types of tasks workers perform. Frey and Osborne assessed the likelihood that these occupations could be fully automated in the coming decades, by considering both the work required in the occupation as well as the engineering obstacles that are currently preventing the full automation of the occupation. Per their study, nearly half (47%) of all jobs could be at risk, but with the risk amplified in emerging economies as opposed to developed ones. The study addresses the evolving landscape of technological progress in that, at one time, robots and computers were used for routine and non-cognitive tasks, however improvements in the space saw advanced robots being able to perform non-routine and cognitive tasks. A follow-up study published in 2017 argues that the occupations most at risk of being fully automated are loan officers, car-insurance assessors, insurance underwriters and credit analysts.

#### **OECD**

In 2016, the Organisation for Economic Cooperation and Development (OECD) released a report that reviews the appropriateness of the Frey and Osborne study, and puts forward its own estimates for the likely impact that automation could have on the abundance of jobs. The OECD adopted the 'task-based' approach in which it quantifies the proportion of an occupation's tasks that can be automated. Across all 21 OECD countries, the organisation's estimate for the portion of jobs that are fully automatable is just 9%.

#### **McKinsey Global Institute**

The McKinsey Global Institute (MGI) is a world-renowned private sector think tank, and it too weighed in on the likely labour market impact of the current pace of technological advancement. In January 2017, it released a report entitled *A Future That Works: Automation, Employment, and Productivity* in which it presents results from analyses that are similar in method to that of the OECD (tasks rather than full occupations). MGI estimates that twenty years from now, 50% of all of today's work activities could be automated, however the proportion of occupations that could be fully automated using today's technology is quite low, at less than 5%.

#### **Summary**

As is the case with most types of forecasting, there is a high level of uncertainty regarding the future of the labour force given the evolution of technologies that are able to replace and improve on human skill. If indeed only 5% of current jobs are fully automatable, it seems like an amount that current labour markets could likely deal with provided that it happens gradually. However, while 5% of jobs may

be fully automated away, many more jobs would see a great deal of their tasks made redundant because of the introduction of automation. In such a scenario, the underemployment rate might be a more telling indicator of the impact on labour markets because of the reduction in the number of hours worked. In the most extreme scenario, the automation of 50% of all jobs would have a profound impact on the labour market as we know it, and the global economy in general.

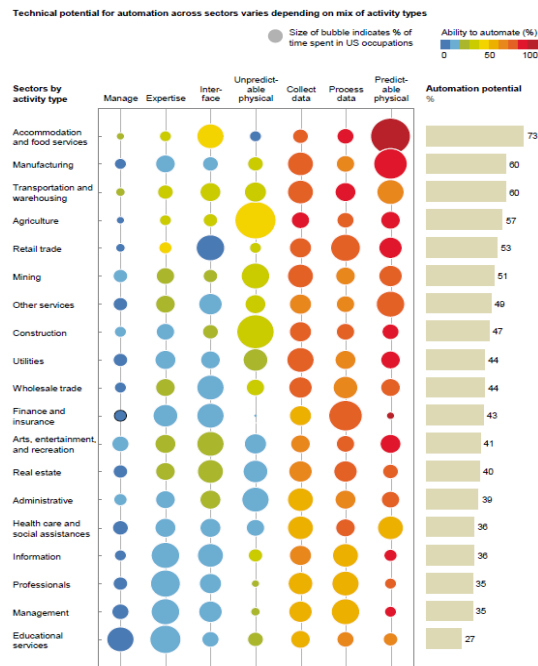
## 1.2 Which sectors are most at risk?

The report previously addressed authored by MGI is one of the better reports at addressing that automation will not affect all industries in the same way. The degree and pace at which jobs can be automated is entirely contingent on the skills required. There are some sectors which will see humans work alongside robots, with the efficiency and productivity of the sector increasing, but with no material impact on the volume of people employed. Other sectors however are likely to see incredible implications for the nature of the work required as well as the number of people employed in the sector.

No matter how advanced AI becomes, it is likely that some jobs will continue to be better performed by humans – particularly those that require emotional capabilities, as well as empathy and social interaction. Similarly, tasks such as interacting with customers, relying on expertise to make decisions, creative tasks and managing people are also unlikely to face automation. But tasks that are routine and predictable, particularly those that involve physical labour, operating machinery, and collecting and processing data are optimal for robots to do rather than humans. Robots would improve the efficiency, safety and convenience of the tasks.

Per the figure below, MGI outlines the likelihood of certain sectors to be prone to automation, based on the activities required in each sector. Not surprisingly, the sectors that rely heavily on tasks that are predictable and physical, as well as ones that are reliant on the collection and processing of data, are the ones that are most at risk of being automated – particularly accommodation and food services, as well as manufacturing. The sectors that are less likely to be impacted are those that require the management of people and projects, and task-related expertise. MGI’s analyses relates primarily to the US labour market, however we consider it appropriate to consider its analyses relevant across most developed market countries because of the similarities in tasks within certain professions.

**Figure 1: Automation Potential by Labour Market Industry Sectors**



Source: McKinsey Global Institute

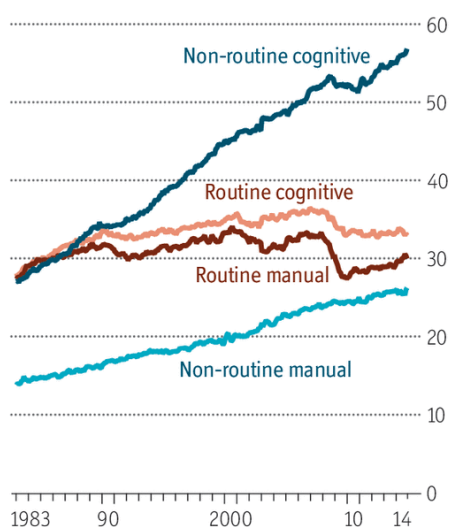
As compared to past technological revolutions (particularly the First and Second Industrial Revolution, which we discuss in the latter half of this feature article), the impact of technological change is set to be so all-encompassing that advances in one sector have the potential to have spill-over effects for other sectors. Past periods of change have revolutionised the manufacturing sector, but the change that we are currently seeing actually has the potential to be incredibly disruptive for the services sector. Part of this is the cost of automating physical labour, as opposed to the cost of automating routine white-collar tasks. The cost of developing software to replicate office-related tasks continues to be far cheaper than purchasing robots to perform physical labour tasks, so it could be white-collar jobs that see the fastest pace of change in the coming years. For example, in the finance sector, per MGI’s analyses, approximately 43% of the tasks are automatable, which could occur more quickly because of the relative cheapness of automation as compared to a sector which has the potential to be more highly automated, but is more expensive to do so.

## 1.3 The Current and Future Impacts

The chart from *The Economist* below shows the implications that the Digital Age has already had on different types of employment in the United States. In 1980, there was approximately the same number of jobs considered to be non-routine cognitive, routine cognitive and routine manual. The introduction of modern day technology has

drastically changed this landscape with there being almost double the number of jobs classified as non-routine cognitive than routine cognitive and routine manual. This gets to the heart of the issue when it comes to the Digital Age – the disappearance (or limited growth) of jobs for lower skilled workers. Economists call this effect skill-biased technical change, which refers to the shift of demand toward more highly skilled workers relative to the less skilled as a result of technical progress.

**Chart 1: US Employment by Type of Work, Millions, 1983 - 2015**



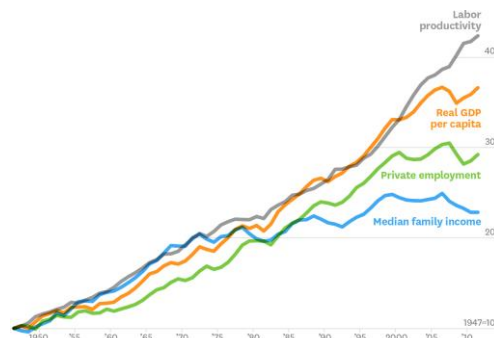
Source: *The Economist*

We will continue our argument with the United States, but it is important to note that these trends have been evident in several other developed countries as well. In the decades following World War II, workers in the US were striving for the American dream, by working harder with the hope of earning more money and having a better life. It was working, as evidenced by several key indicators of an economy’s health: per capita GDP, labour productivity, the number of jobs and median household income. As per the chart below, from the 1950s to the 1980s, all four of these measures were increasing together. In other words, the number of jobs available and the wages earned were increasing as labour productivity and GDP growth were increasing. Workers were creating more wealth and also seeing the benefits themselves.

This was a trend first noted by economist Erik Brynjolfsson and his colleague Andrew McAfee, and the divergence of these measures in the 1980s is a trend that they have called *The Great Decoupling*. In the 1980s, median household income growth began to slump, and when adjusted for gains in inflation, it turned negative. An American household at the median income level earns less in real terms today than it did 15 years ago. Job growth also flattened

throughout the 2000s, despite strong economic growth during the period (aside from during the financial crisis of course). So over the past thirty years, the measures of headline economic strength (productivity and GDP growth) have diverged from the measures of economic prosperity for the country’s workers (household income and job growth). In Brynjolfsson’s and McAfee’s words, the metrics have decoupled.

**Chart 2: Labour Productivity, GDP per Capita, Private Employment and Median Family Income, 1950 - 2015**



Source: *Harvard Business Review*, Erik Brynjolfsson and Andrew McAfee, *Federal Reserve Bank of St. Louis*

This period of decoupling coincides with the Digital Age, specifically the introduction of the computer and the Internet into the workplace. It is important to note that there are other factors at play that have also caused the slowdown in wage growth, including the offshoring of many jobs, particularly those in the manufacturing sector and in call centres to developing countries that pay lower wages. The financial crisis of course was a factor as well, however the recovery in economic growth but the stagnant wages since suggest that there is more at play than just the recessionary effects.

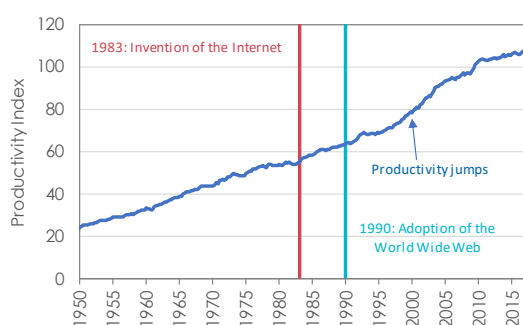
We believe that technology is the most dominant force at play with this decoupling trend, and with even more serious implications for labour markets still lying ahead, this divide could be set to get worse. Workers will continue to get smaller and smaller pieces of the pie, while companies will be eating more than their fair share. Flatlining or falling employment opportunities and wages will exacerbate income inequality in the short term, but in the long term, the implications could be far more serious. What happens in a world where the labour force shrinks by a large multiple? How do people afford to live? How can an economy continue to grow if it can no longer depend on consumer spending? These are troubling questions, ones that developed market countries have had to deal with in the past, but the current economic climate might not make them as straightforward to answer this time around.

### 1.3.1 The Benefits Should Not Be Overlooked

In almost every era of technological change, there has been fear that human labour will be largely replaced by whatever technology was the talk of the town at the time. The result has historically been however, that, yes jobs have been lost, but more interesting ones have been gained. The workforce has changed through time, to one when it was dominated by physical labour in agricultural settings, to routine labour in factories, and then to white collar jobs in offices.

In 1987, Robert Solow, a Nobel-winning economist, pondered about the disconnect between the massively improving technological advancements in the workplace and the slump in productivity, 'you can see the computer age everywhere but in the productivity statistics'. The Internet had recently been invented and the use of computers had become much more widespread in workplaces, yet productivity had not picked up as was expected. But several years later, in the mid to late 1990s, the benefits of computers and the Internet was finally starting to appear in the productivity data. This can be seen in the chart below with the red line coinciding with the invention of the Internet, the aqua line representing the adoption of the more usable World Wide Web, and the blue line representing productivity as measured by the real output per hours worked across all persons. It was not until several years after the adoption of the Internet that productivity ticked up.

**Chart 3: Productivity within the US Labour Market: 1950 - 2017**



Source: Federal Reserve, Whitehelm Advisers

A similar trend was observed following the adoption of very powerful and new technologies such as electricity and the internal combustion engine. It goes without saying that these technologies have revolutionised manufacturing, but even after they were first introduced, US labour productivity growth was extremely low for the first three decades of the 1900s. Only after manufacturers learned how to more efficiently harness the power and efficiency of such technologies did we see an uptick in labour

productivity. At this juncture, it is important to note that the current Digital Age is still in its infancy. The current period of technological change could in fact be very beneficial in terms of productivity growth, we may just have to wait a few years to see the results in the economic data.

### Automation could help developed markets deal with their ageing populations

A much-discussed issue in many developed market countries over the past several years has been the impact that the ageing of the baby boomer generation and the increasingly longer life expectancies could have on developed market economic growth over the coming decades. An ageing population means that the labour force will shrink markedly. The introduction of automation could help bridge this gap.

Economists Daron Acemoglu from MIT and Pascual Restrepo from Yale address the theories regarding the relationship between changing demographics and economic growth and productivity in a January 2017 paper entitled *Secular Stagnation? The Effect of Aging on Economic Growth in the Age of Automation*. The economists address that many economic theories have been predicting that the ageing populations will be deleterious for economic growth because of the falling labour force participation rate, falling productivity, excess savings and lower investment. They argue that, despite the shrinking labour forces in many developed economies, economic growth and productivity have yet to fall off, and is largely attributable to the rapid adoption of automation technologies in such countries.

The chart below shows that so far there has been no evidence between 1990 to 2015 that ageing populations are having a material impact on GDP per capita growth. The OECD countries are concentrated to the right of the graph because they are experiencing a higher rate of ageing than non-OECD countries. However, the GDP per capita growth rates are not materially different for countries that are ageing and those that are not.

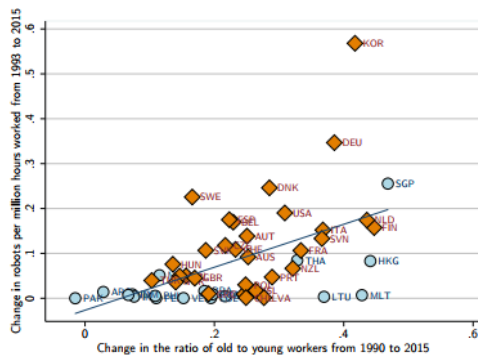
**Chart 4: Relationship between GDP per capita Growth and Ageing Populations**



Source: UN, IFR, Daron Acemoglu and Pascual Restrepo

The period of measurement is from 1990 to 2015 – a period that experienced rapid technological change with the adoption of the computer and the Internet in almost all workplaces and homes. Firms have been provided many opportunities to adopt automation within the production process. In the chart below, they show that there is a correlation between ageing populations and the adoption of robotics, if South Korea is excluded as an outlier.

**Chart 5: Relationship between Adoption of Robots and Ageing Populations**



Source: United Nations, IFR, Daron Acemoglu and Pascual Restrepo

It is important to note the difference between correlation and causality, and the authors of this paper are sure to point out that the adoption of robots is not the only factor at play that has so far neutralised the negative implications of population ageing on economic growth. That said, automation does present a potential source of neutrality for potential harmful effects of ageing going forward.

### 1.4 This is not a new issue...

Knowing where on the spectrum the impact on labour markets will be is incredibly difficult. Previous examples, including the First and Second Industrial Revolutions, show us that the labour market has been able to adapt to technological change in the past, but these periods did not occur without incident and short-term pain. That said, in this section, we point out why these two prior periods of technological change do not necessarily provide the best precedents for the one that we are currently in the midst of.

The First Industrial Revolution occurred from approximately 1760 to the early to mid-1800s, in which manufacturing processes were transitioned from being largely hand production methods to machines. The change enacted during this era was widespread and included new methods for chemical manufacturing, iron production, steam power, water power, and the increasing popularity of the factory system.

Also known as the Technological Revolution, the Second Industrial Revolution ran from the mid to late 1800s until the start of World War I. Significant advancements in production and manufacturing technology allowed for the widespread adoption of pre-existing technological systems that had only been adopted in a few key cities. Such systems included telegraph and railroad networks, sewage systems, and gas and water supply. New systems were also introduced, including telephones and electrical power, and by the end of the Second Industrial Revolution, factories saw significant productivity and efficiency improvements, including the introduction of electricity to factories, as well as the production line.

The two Industrial Revolutions improved the standard of living markedly, in terms of enhancing public health, sanitation and transportation. Globalisation was essentially kicked off because of the freer and easier movement of people. Manufactured goods became cheaper and far more accessible. In terms of the impact on the way we work, the two Industrial Revolutions made drastic improvements to the way goods are manufactured. The invention and introduction of many different technologies had a material impact on efficiency and productivity, not necessarily instantaneously, but once the true power of the new technologies was understood and harnessed.

The middle class was essentially borne out of these two past periods of technological change because of the impact that they had on the earning potential of the lower-skilled workers. Employment opportunities were the most plentiful for those willing to do manual labour and work on factory production lines, and their wages were attractive. Higher-skilled workers bore the brunt of the change because they quickly saw their crafts being replaced by more efficient manufacturing processes. Many lost their jobs and had to find other work. From polarised societies where there was the rich and the poor arose societies where there was more of a gradient of social class and wealth.

It is for these reasons that it is difficult to use the First and Second Industrial Revolutions as precedents for the Digital Age that we are currently in the midst of. In the first two Industrial Revolutions, the technological change was focused on certain key sectors, and was predominantly focused on the drastic improvement of efficiency within the manufacturing sectors. The current wave of technological change does not discriminate among sectors however, given that every industry uses computers in some shape or form. The continued involvement of their power and prowess will likely impact every sector.

The invention of computers and then the Internet, and their subsequent introduction to workplaces improved the productivity of high-skilled workers much more than it did low-skilled workers. Low-skilled workers became at risk of losing their jobs altogether because routine-intensive occupations were the ones most at risk of being automated. Some fields of work were almost entirely eliminated, while others have seen their demand fall drastically. This trend has continued for decades after the widespread adoption of the computer in workplaces. It will not be as easy as finding other routine and unskilled work, it could be a matter of being forced to completely retrain and learn a new set of skills to stay ahead of the automation curve.

But for high-skilled workers, the last 30 years have meant improved productivity in terms of occupations dependent on abstract thinking, problem-solving and creativity. Improving productivity typically causes wages to increase, which has exacerbated the issue of inequality, rather than reducing it like past periods of technological change has done. The Digital Age has already caused a deterioration of the middle class, the formation of which has been one of the most beneficial outcomes of the Industrial Revolutions.

It would be very convenient to point to the First and Second Industrial Revolutions as proof that the global economy can recover from periods of immense technological change. But it would also be naïve to do this, given both the fundamental differences in the extent of the change as well as the differences in the economic climate between then and now. Developed market countries have been grappling with low growth and low inflation for years now, income inequality is getting far worse rather than getting better and job polarisation is happening at an alarming rate. Turning a blind eye to the potential implications is not recommended.

### 1.5 Governments and Central Banks Forced to Act?

In most developed market countries, household spending is by far the largest single contributor to GDP growth. In the United States, it accounts for two thirds of GDP. A sharp rise in unemployment caused by automation, would have a significant impact on household disposable income, which would spell trouble for governments who have relied on this source of growth for centuries. In the paragraphs that follow, we discuss some potential ways to mitigate the downside risks, that will need to be prioritised by governments and central banks.

### Universal Basic Income

With apocalyptic predictions for the number of jobs that could be impacted by automation and AI come calls for a plan and a need to redistribute wealth. A falling demand for human labour means that the transmission mechanism that has historically been used for distributing wealth (wages) will no longer apply. The concept of a universal basic income (UBI) has been proposed as a potential mechanism. UBI involves payments to all citizens, both working and non-working, to supplement irregular income as a result of the automation of all or part of their job. It would provide a safety net to fall back on when people are unemployed or retraining to re-enter the workforce. UBI would not change for people who work more or for people who earn more. Instead it would provide people an increased level of freedom to decide how many hours they would prefer to work, and would afford people the opportunity to retrain to keep pace with the changing labour market demands. It would also help maintain a moderate level of consumer spending if we are to see a sharp increase in the unemployment rate.

A less extreme form of UBI would be a wage insurance, a concept put forward by the Brookings Institute. Wage insurance would involve government payments that would supplement the earnings of workers that have been laid off and who have to take less high paying jobs in order to re-enter the workforce. The insurance would reflect the changing dynamics of the workforce and would allow for less predictability in future household disposable income. The downside of both UBI and wage insurance however is that either would come at a very significant expense to governments.

### The Robot Tax

A significant worry for global governments if robots do enter the workforce at higher and higher rates is the implications this would have for the income tax that it collects on an annual basis. All employed humans pay an annual income tax that the government uses for a variety of purposes. If robots take the jobs of humans, one of the governments' main sources of funding will decrease drastically. Bill Gates has been a vocal proponent for the concept of a 'Robot tax' that would help offset this fall in government funding.

Gates' proposal of a robot tax has not come without criticism however. Taxing companies who utilise robotics technology may discourage others from adopting the technology altogether, which while positive for those employed over the short term, could have negative implications for productivity over the longer term. The globe has been grappling with the issue of low productivity for many years

now and taxing the things that might improve productivity would likely diminish the benefits.

### Monetary Policy

If current trends continue with regards to the pace of automation, wage inflation and employment opportunities, central banks may be key to helping economies navigate the rough waters. Most governments of developed market countries are already severely indebted, so central banks may be called on to carry the burden rather than having the governments implement massive spending plans that would be necessary for either UBI or wage insurance. Increasing unemployment could cause central banks to lower interest rates to try to stimulate some amount of consumer spending. Global central banks currently do not have very much flexibility to be more accommodative given their easy monetary policy stance which has been in place for almost a decade. It is concerning if today's monetary policy was the starting point for being more accommodative, however we believe that this is a longer-term issue – and hopefully central banks will have been able to normalise monetary policy before being called on to help economies adjust to the 'new normal' when it comes to automation and the labour force.

### 1.6 Implications for Financial Markets

There are some very significant implications, particularly under the extreme scenarios, for financial markets. From an equity (and debt) perspective over the short to medium term, the introduction of AI as a form of cost out and increase in productivity is obviously a good thing if the equation stacks up. This results in falling costs and increasing profits. Over the longer term however, if a significant increase in widespread underemployment eventuates, GDP will be lower, meaning slower sales growth and therefore fewer profits. That is, companies could ultimately be a victim of their own success. This is an extreme scenario and one that is unlikely to pan out, at least in the next decade anyway.

Consistent with this trend though is a deflationary theme. That is, a path of declining wages and reducing prices is deflationary and could result in an extended period of very low interest rates whereby central banks are unable to get out of their current

monetary policy settings. But this assumes there are not benefits. There would be much investment and, in turn, job creation coinciding with the construction, installation, and maintenance of AI. So, there will be gains as well as losses. Increasing productivity to offset an ageing demographic would be a very positive development for equities. These will not be quick adjustments though, these changes will play out, for better and worse, over the next few decades.

### 1.7 Conclusion

Digital technologies continue to surpass expectations, and are allowing societies to overcome limitations at breakneck pace. But with it has come some very difficult issues to deal with, primarily the falling demand for certain types of workers, typically those in the lower to middle class who are unskilled and do routine work. How the labour market and economy will grapple with these issues going forward continues to be entirely uncertain. To date, we have seen signs that job polarisation is well underway, with a hollowing out of the middle class. Wage growth has been slow, productivity has been lower than in past periods of change, and income inequality is worsening. But, automation could also help bridge the economic gap in developed market countries caused by ageing populations and lower birth rates.

That said, we consider this an issue that could materialise over the long-term, as in the next few decades. Current market trends continue to point to labour markets being robust enough in the near term to handle the big-ticket items of ensuring that the volume of jobs grow as the population grows, but current and future technology has the potential to be far more destructive over the long term than we can even conceptualise. This is an issue that should be of note and of interest to Australian superannuation funds, one that will not likely impact investment decisions over the near term, but one that could have fundamental implications over the longer term.

Here's to robots not being able to write these feature articles anytime soon!

*This feature article is a condensed version of a more in-depth article. If you are interested in accessing the longer-form version, contact Nicole McMillan at [Nicole.McMillan@WhitehelmCapital.com](mailto:Nicole.McMillan@WhitehelmCapital.com)*